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ABSTRACT

Instructors who teach outdoors in an environment so cold as to cause injury must satisfy program objectives while avoiding cold injury to themselves and students, help students focus on learning instead of discomfort, and alleviate some students' intense fear of the cold. Dealing with the cold successfully requires a thorough knowledge of: physiological reactions to the cold (shivering, vasodilation); fundamental laws of heat transfer; the causes and current treatments of the most common cold injuries (snowblindness, earache, dehydration, chilblains, hypothermia, and frostbite); and some specific techniques for staying warm (proper clothing properly worn, sleeping warmly, group shelters, "huddling"). Prior to the actual field experience instructors should alleviate fear of the cold by talking about it; teach students about cold injury, the appearance of a healthy body, and techniques for staying warm; establish communication with the students; and conduct a preparatory overnight trip. During the field experience itself instructors should teach by example; guard against dehydration; assume nothing about a student's knowledge or ability until it is observed; transfer much of the responsibility for keeping warm and healthy to the students; and maximize successes. Evaluation of the experience will improve future cold-environment outdoor teaching. (SB)

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TEACHING IN A COLD ENVIRONMENT

by

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TEACHING IN A COLD ENVIRONMENT

With the dramatic growth of Outdoor Experiential Educational Programs the probability of students being placed in a cold environment becomes greater. As Outdoor Educators, the problems and potentials increase anytime our students and the cold meet. Problems in dealing with fear, comfort-mindedness, cold injury and short amounts of time all become paramount to the instructor. Fortunately, potentials also arise with an increased sense of accomplishment, self-concept, and ability to deal with a foreign, often hostile environment. The key to a successful program lies in treating the cold as a problem which can be dealt with while still accomplishing the program goals and objectives.

This paper was written in an effort to give the instructor some workable and practical ideas for dealing with students in a cold environment. Because of the large amount of literature on the subject an effort was made to make the report adaptable to individual needs. To do this the report is divided into three sections. Section 1 deals with what a cold environment is, some fundamental laws of heat, and some physiological reactions of the body when placed in a cold environment. Section 2 lists the most common cold injuries and current treatments. Section 3 presents techniques the instructor might use in dealing with students in a cold environment.

SECTION 1

In this report a cold environment is meant to be an outside area where the temperature is low enough to cause a cold injury. Cold injuries include: chill blains, immersion foot, hypothermia, frostbite/frostnip. In an educational sense, cold can also inhibit learning because students naturally focus in on the cold and nothing else when they are uncomfortable. Consequently, this uncomfortableness must also be dealt with.

When concerned with people in a cold environment several factors need to be considered. The instructor will find a thorough understanding of cold physiology valuable in forming his/her method of teaching students to combat the cold. Let's start with the basics and from there formulate some cold weather strategy.

The human body produces heat in three ways:[1] 1. basal metabolism 2. exercise 3. thermoregulatory. Heat produced by basal metabolism arises from essential processes of life, is of a slowly altered, fixed rate, and is partly controlled by the thyroid gland. This fact may eventually be exploited in treating hypothermia.

Exercise can liberate vast amounts of heat for short periods of time, and is the product of the chemical reactions within the muscle tissue. For the most part, exercise is thought to consist of useful movements which distinguishes it from the third source of body heat, thermoregulatory.

Thermoregulatory heat production is the end result of deliberately wasteful metabolism and has a primary function of producing heat. A common example of this is shivering. Shivering can increase heat production by five times and uses up energy to the equivalent of a slow jog.[2] Unfortunately most of this heat, (nearly 90%) is lost from the body through convection.[3]

Heat production can be interfered with by three ways. These include:

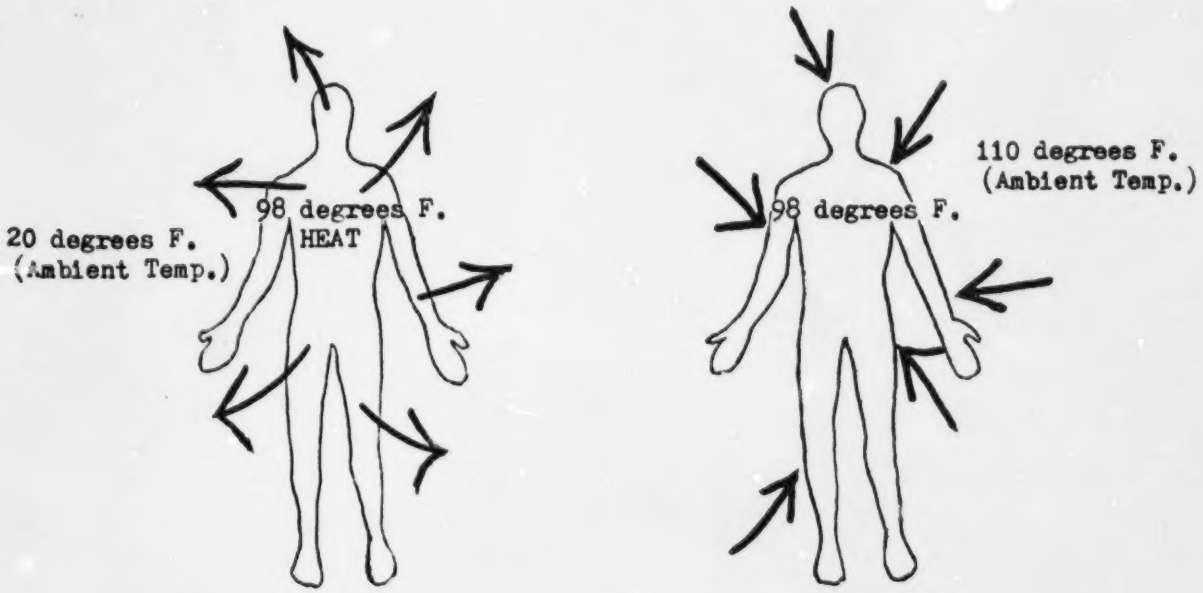
1. Insufficient amounts of oxygen (high altitude, carbon monoxide).
2. Inadequate circulation (impaires waste disposal, oxygen and nutrient uptake by cells).
3. Failure of nervous system to sense, initiate, and regulate body functions, (alcohol, drugs, or fatigue).

Where this heat is produced may be of interest when trying to decide where and how to insulate. The following chart illustrates where and how much heat is produced.[4]

BODY AREA	RESTING	ACTIVE
BRAIN	16%	3%
CHEST/ABDOMEN	56%	22%
SKIN/MUSCLES	18%	73%

HEAT PRODUCTION IN VARIOUS BODY AREAS AT RESTING AND ACTIVE STAGES

When discussing how the body loses heat a fundamental law of physics comes into play. Simply stated, heat will always move to a colder environment. If the environment is less than 98 degrees F. (37 degrees C.) the body will "give off" heat. This concept is illustrated below:



With this factor in mind, the body loses heat in five ways:[5]

1. Conduction - The transfer of heat by direct contact with a cooler surface.
2. Convection - Carrying away of heat by moving molecules of air or water.
3. Radiation - Heat loss from the body to a cooler environment via infrared waves.
4. Evaporation - Loss of heat from the body when water is transformed into water vapor (540 calories are required to convert a gram of water to a gram of vapor).

5. Respiration - Heat lost when inhaled air is raised to body temperature and then exhaled. Heat lost through respiration can account for more than 20 per cent of the body's heat loss.[6]

When exposed to the cold the body elicits several physiological reactions. Initially, temperature sensors in the skin and hypothalamus are triggered which in turn cause the person to "feel cold".[7] This "cold" feeling usually causes a person to seek shelter, put more clothing on, build a fire, or huddle with others - but not always, a fact vitally important to us as outdoor instructors.

Shivering is another heat producing function by which the body combats a negative heat load. Shivering as previously mentioned, can liberate large amounts of heat but is generally considered inefficient. Inefficiency results from the fact that active moving muscles require an increase in the circulation of the skin, which in turn exposes more warm blood to the cold environment thereby causing a heat loss.

A process akin to shivering is the excitation of the muscles at the base of skin hair follicles, also known as goosebumps. By creating a goosebump the body causes its skin hair to stand upright thereby creating a thicker layer of still air surrounding the body. This in turn reduces the amount of convective heat loss and conserves body heat.

Another physiological reaction to cold is termed non-shivering thermogenesis and is related to the release of certain hormones (catecholamines; epeinephrine and norepinephrine) within the body.

These chemicals increase the metabolic rate and cause an increase in available body heat.[8] With the addition of these hormones a greater increase in; oxygen consumption, blood glucose, blood pressure and decreasing heart rate are also evident.

Norepinephrine also appears to be responsible for another of the body's attempts to increase insulation - vasoconstriction. With a cold stress, the blood vessels in the extremities - the hands, feet, ears, nose, etc. constrict forming the "capillary shunt" .[9] This constriction effectively reduces the amount of blood close to the "colder" body surfaces, but subjects the affected area to a freezing injury. One result of this vasconstriction is a cooler skin temperature and a more stable internal temperature.

As a person acclimatizes to the cold, his basal metabolic rate increases and the temperature at which the shivering response is activated is lowered. Heavier people appear less susceptable to heat loss than average or ectomorph body types.[10] Chronic cold exposure also seems to "lessen" the person's sensitivity to the "cold feeling".

ENDNOTES

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[2]Carlson, L.D. and Hsieh, A.C.L. (1965) Cold. In: Edholm, O.G., and Bachrach, A.L., (Eds.) The Physiology of Human Survival, 15-52, New York Academic Press.

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SECTION 2

COLD INJURIES AND THEIR TREATMENT

Cold injuries (injuries which result from the body's exposure to a cold environment) can and often take place in progressive manner. With this in mind, cold injuries and some treatments will be discussed in order of severity beginning with the milder forms of injury. The following are injuries or ailments commonly associated with cold environments.[1]

snowblindness: Characterized by the eye being exposed to too much solar radiation. Treatment involves cold compresses, a dark environment, and covering the eyes.

windburn: A burn like irritation which can be alleviated by a grease or oil based ointment

sunburn: A first or second degree burn prevented by using clothing, opaque ointments, or lotions containing aminobenzoic acid (PABA).

earache: an irritation of the eardrum by the wind. This is prevented by placing a plug of cotton or soft tissue in the outer ear canal.

skin: Cold, dry weather can lead to dry skin. Excessive washing with soap removes important body oils and inhibits the supercooling phenomenon where skin with its natural oils may be cooled from 32 degrees F.

down to 20 degrees F. for a time before frostbite sets in. Animal or vegetable oils can be used to eliminate dry skin.

beards: A controversial subject, with one school of thought believing a beard keeps the face warm. Another school of thought states that a beard hides the signs of frostbite. Personal experience has shown beards to accumulate ice and can make it difficult to open the mouth when frozen over.

dehydration: Even in a cold environment the body loses moisture to the tune of 2-5+ quarts per day. If not replaced, symptoms including; irritability, deep orange or brown urine, economy of movement, headaches, etc. Dehydration causes the blood to become more viscous which leads to a lessening of cardiac efficiency which in turn decreases the body's ability to carry out its functions. Treatment involves adequate fluid intake. Instructors should note that dehydration appears to be a contributory factor in many student difficulties and complaints.

chillblains: Commonly occurs with repeated exposure of bare skin at temperatures between the low 60 degrees F. and 32 degrees F., (rosy cheeks). The skin is red, rough,

itchy and no loss of tissue. Treatment consists of preventing exposure and a soothing ointment.

immersion foot (trench foot): A cold injury usually associated with the foot, caused by a prolonged exposure to wet conditions,(usually above freezing) for hours or days. With students this can occur when using vapor barrier boots or wearing wet socks and leather boots for extended times. Symptoms include; pain, redness, numbness, and cracking of skin. Treatment focuses around drying feet, warmth, and restoring circulation. The U.S. Navy Polar Manual, (1965) suggests small amounts of alcohol to aid in vasodialation.

accidental hypothermia: A lowering of the body temperature which produces symptoms of shivering, careless attitude, poor coordination, poor speech, irrationality and eventually death. Predisposing factors include; wet, windy, cool conditions and an awareness of the victim as to potential danger. Treatment consists of stopping the heat loss, shelter from the elements, body movement, administering warm fluids, (if conscious) flesh to flesh contact, an external heat source, and gentle evacuation if necessary.

immersion hypothermia: Upon immersion into cold water, 28 degrees F. - 70 degrees F. the body can lose immense heat and produce hypothermia with the attendant symptoms of accidental hypothermia.

Treatment consists of the following:[2]

1. Shore should be less than one mile at 50 degrees F. water temperature before swimming.
2. When without a life jacket, treading water can be more effectively conserved by treading water rather then utilizing the drown proofing technique. While in a personal flotation device, research has shown that survival time can be increased by 50% if the person holds still with the inner sides of the arms tight against the side of the chest, the thighs pressed together and raised. See below illustration.

ILLUSTRATION 3

H.E.L.P.

(Heat Escape Lessening Posture)

Clothing can reduce loss of body heat by as much as 75%. Once out of the water, treatment is similar to accidental hypothermia. Because of the danger of "after - drop", (the sudden drop in body core temperature caused by blood being sent to a cold periphery, being chilled and returning to the inner body) only the body core, (head, neck, and trunk) should be donated heat via warm showers, warm water poured over the core and warm baths. If victim is unconcious administer mouth to mouth resuscitation.

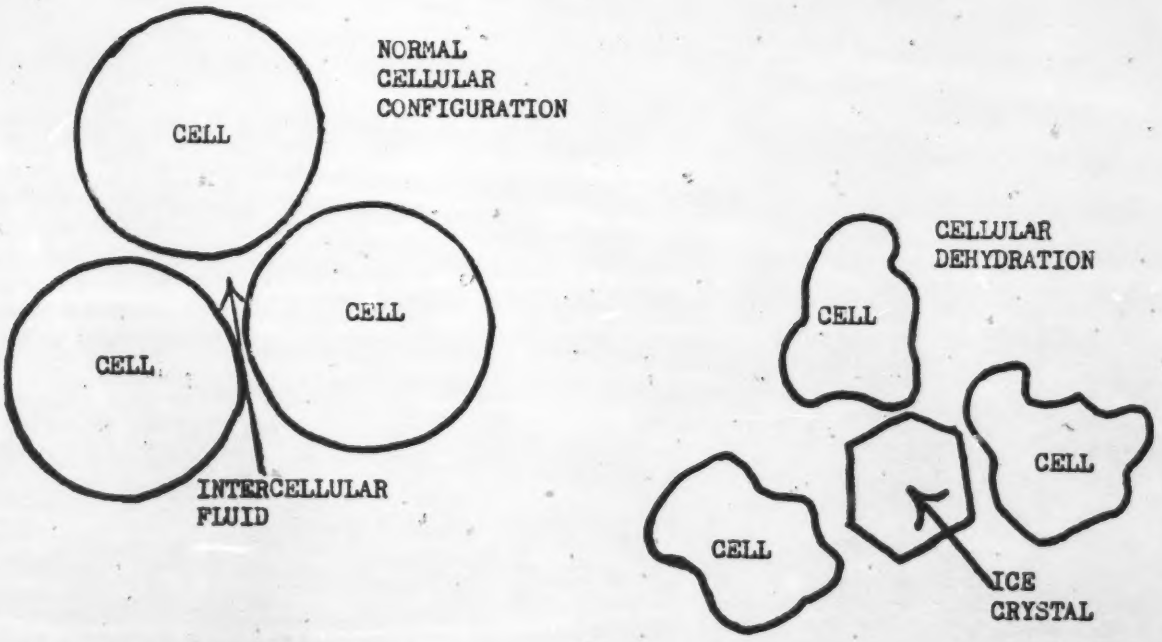
"frostbite" of the lungs: Associated with heavy breathing in a cold air environment. Symptoms include; breathing discomfort, coughing, asthmatic type reactions, and coughing up blood. Treatment consists of pre-warming the air (hoods, masks, etc.), humidifing the living environment if possible and eliminate smoking.

frostnip: The only type of frostbite which can be considered medically inconsequential, and can adequately be treated "on the trail". It is a sudden blanching (whitening) of the skin usually located on the ears, fingertips, tips of toes, nose, cheeks, or chin. Treatment consists of rewarming the part by a warm hand, warm stomach,

or armpit, (any warm spot on the body) or by blowing warm air on the affected part. The "buddy system" of watching one another coupled with constant personal vigilance is particularly effective.[3]

frostbite: A true medical problem which involves actual tissue damage. When tissue is chilled below freezing, two phenomena take place: first, capillary beds constrict, become damaged, and the blood becomes viscous or sludges, all of which inhibit circulation to the area. Secondly, ice crystals begin to grow between the individual cells. Damage occurs from these ice crystals drawing off water destined for the individual cells and causing the cells to dehydrate, as illustrated below:

ILLUSTRATION 4



INTERCELLULAR ICE CRYSTAL GROWTH

Cellular injury is also caused by the disruption of nutrients, waste elimination, and oxygen uptake. Symptoms of superficial frostbite include; a white waxy appearance, numbness and resilience to touch. Upon rewarming, the area becomes mottled, blue or purple and usually stings or "burns" for a period.[4]

Deep frostbite, (freezing) differs from superficial in that it involves not only the skin and subcutaneous tissue but also muscles, bone, tendons, etc. The affected part becomes rigid, waxy colored, cold to the touch and painless when unthawed. Some tissue loss is usually expected.

Treatment of frostbite for the field instructor's uses involves; identification of injury, protection of injury, and evacuation to a medical facility. As differentiated from frostnip, frostbite is a true medical problem which is best treated by qualified medical personnel in a hospital setting.

ENDNOTES

[1]Hedblom, MC, USN, U.S. Navy Polar Manual, 1965.

[2]Man in Cold Water, brochure by the University of Victoria.

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SECTION 3

TECHNIQUES AND METHODOLOGIES

When faced with conducting a class or program for students while in a cold environment, the outdoor instructor is confronted with several problems. He must attempt to satisfy the objectives of the course while avoiding cold injuries to both his students and himself. Secondly, his students will be focused in on creature comforts, in this case staying warm, and tend to disregard everything else, hence learning may be at a new all time low. Finally, depending on the severity of the cold, some of our students will experience an intense fear of the cold to the point of thinking they are doomed to freezing to death. These metodology and techniques may be utilized by the instructor when working in a cold environment. (See Illustrations 5, page 21).

MAJOR CONSIDERATIONS WHEN IN A COLD ENVIRONMENT

1. Alleviate fear of the cold - talk about how to deal with it, suspect it in everyone until proven otherwise.
2. Dehydration - should be avoided since it inhibits both the body's functions and its ability to keep warm.
3. Awareness - make your students aware of what their body (feet, hands, head, etc.) looks and feels like when they are healthy so they may be able to notice when they are not.

4. Communication - should be an important part of your student rapport. Students should feel like they can and should tell you when abnormally cold or ill.
5. Teach by example - rather than words. Students often emulate you and if you show correct cold weather field techniques - so will they.
6. Assume Nothing - as to what your students know or can do without first doing some checking and observation.

TECHNIQUES FOR HELPING STUDENTS STAY WARM WHILE IN THE COLD

The following list is by no means a complete summary of techniques you as the outdoor instructor can utilize. Doubtless you have your own, which work equally as well or better. The following are ideas you might want to include in your cold weather "bag of tricks". The assumption is made that the outdoor instructor already possesses basic cold weather skills, teaching methods, and common sense in the outdoors:

1. Use a hat to regulate body heat, particulary the back of the head and neck. (a cold brain is a numb brain; only dumbrains get numbrains).
2. A scarf or earband can be a valuable & adaptable piece of clothing.
3. There are no "little jobs" at temperatures less than -30 degrees F.
4. Moderate amounts of alcohol neither significantly increases total body heat loss nor decreases heat production and may actually

enhance an individual's tolerance of cold injuries through vasodialation.[1] Overindulgence can lead to poor judgement and interference with the shiver reflex.

5. Hot drinks usually add a very small amount of heat to the body mass, however, hot drinks produce an immediate peripheral vasodilatation which can have a positive effect.[2]
6. Smoking acts as a vasoconstrictor and decreases the circulation to the fingers and toes and increases the possibility of cold injury.[3]
7. Insulated cups are preferred over metal containers in cold weather for retaining food warmth.
8. Lack of body movement predisposes cold weather injury through a decrease in periphery circulation.
9. Lack of body movement decreases body heat loss in cold water immersion.[4]
10. To prevent their faces from freezing, arctic explorers often "made faces" to stimulate circulation.[5]
11. When using clothing follow the letters:

    C - keep your clothes CLEAN

    O - avoid OVERHEATING (sweating)

    L - wear your clothes LOOSE and LAYERED

    D - keep your clothing DRY
12. A light dacron vest that covers the thorax, kidneys, and upper belly conserves large amounts of body heat.[6]

13. Pull thumbs into palms, and arms out of sleeves and inside parka if they become extremely cold.
14. Blacks are more susceptible to cold injurys than caucasians.[7]
15. Hypoxia from high altitudes causes an increase in blood flow to the surface with an increase in body heat loss.[8]
16. An overboot or wool sock covering over ski boots reduces heat loss through the foot.
17. Have students assume responsibility for both themselves and others to prevent cold injuries. Place responsibility upon the students as well as yourself.
18. In inclement weather have students form a half circle with their backs to the wind. When giving a talk, be sure it is concise, understandable and to the point.
19. An overnighter before the actual field trip often prepares students in a realistic and effective manner in dealing with the cold.
20. If using tarps, place them end to end thus creating one large shelter, ("circus tent") this will enable the instructor to monitor the group as a whole.
21. If feet are cold after the shelter has been erected, one way to warm them is to have students dry their feet, change to dry socks, and sit in a circle with their feet to the center. Cover their feet with a sleeping bag and have them wiggle their toes. Hence the instructor can talk to the group while the students warm their feet, (Snakeballing).

22. Zipping sleeping bags together can allow the students to pass a cold night safely.

23. Leakproof water bottles filled with warm water can pre-warm cold sleeping bags besides providing unfrozen water in the morning.

24. If overheating is a problem, besides removing the hat, mittens, etc., unzipping pants or pulling pants above knees can effectively eliminate surplus heat.[9]

25. Consider the following chart, (Illustration #6) when in a cold stress environment:[10]

FACTORS WHICH AFFECT COLD STRESS

INCREASE	DECREASE
WIND	INSULATION
WETTING	HUDDLING*
EXHAUSTION	SHELTER
INJURY	SOLAR RADIATION
DRUGS	EXERCISE
HYPOXIA	

* Animals huddle together to increase over-all body size which decreases exposed body surface besides creating a wind break. Humans may want to utilize the same principle.

ILLUSTRATION #5

COLD WEATHER STRATEGY

Before Students Arrive:	ANALZYE	Students Area/Temperature Program/Equipment
Upon Arrival of Students:	DISCUSS	Fear of the Cold (i.e. Initiative Games - "Fear in a Hat", etc. Guided Discussion Stories).
Prior to Outdoor Field Experience:	TEACH	The Mechanics of Cold Injury How to Stay Warm
	PREPARE	Give Students Trial Run Progressive Exposures to Cold Simulations
Field Experience:	OBSERVE	Students for correct: Procedures Actions Awareness Correct Immediately and Firmly Explain the Why's and What for's
	TRANSFER AND CHECK	Responsibility for staying warm and healthy onto the students while maintaining some control for possible mistakes
	MAXIMIZE SUCCESS	The cold can be successfully dealt with, instill this self-confidence into your students
After Student Departure	EVALUATE	What went right, what went wrong, how to improve on dealing with the cold

This report has been an attempt to aid the outdoor instructor in dealing with students in a cold environment. Hopefully the instructor will be able to glean some techniques from this report and combine them with the methods s/he already uses in dealing with students. With the goal of producing successful and safe outdoor courses while in a cold environment almost any method that works and is safe can be considered a good one. Since effectivily dealing with the cold is an active, rather than passive art, using direct, effective techniques, however small, can often mean a successful cold weather outing instead of a trip to the hospital.

ENDNOTES

[1]Goldman, Ralph, Newman, Russel and Wilson, Ove. "Effects of Alcohol, Hot Drinks, or Smoking on Hand and Foot Heat Loss", Institute of Aviation Medicine, 1972, p. 499.

[2]IBID, p. 499.

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[10]Moore, R.E., "Physiology of the Response to Low Temperature", Mountain Medicine and Physiology, Alpine Club, London, 1975, pp. 12 - 13.

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